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ABSTRACT

Prepared for a 1984 Organisation for Economic Cooperation and Development (OECD) conference, this report discusses the potential of the new information technologies for enhancing learning in school, vocational, and general education, and presents eight groups of case studies taken from member countries which illustrate what is currently being done to help individuals, organized groups, social and political organizations, and businesses and institutions to come to terms with these technologies. Organized along a continuum, the first group of cases includes one-time, small scale events, while the last group involves permanent, highly structured bodies. The cases summarized focus on the following areas: computer camps, plays, festivals and fairs; permanent museum centers and exhibitions; programs enhancing school industry relationship; LOGO programming language use with potential drop-outs, students with learning disabilities, and young children with Down's Syndrome; telematics, including viewdata and teletext; general education within the school system; computer literacy for general audiences through the British Broadcasting Corporation; and France's Centre Mondial Informatique and Italy's FORMEZ, an adult education agency. The challenge posed by the new information technologies to formal education is discussed in terms of curriculum, methods, delivery systems, teacher training, lifelong learning, equal education, and the new information society. (MBR)

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Château de la Muette
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INFORMATION SOCIETY AND GENERAL EDUCATION

1. The attached document has been prepared by Giovanni Lariccia, National Council for Research, Rome, Italy, and Jacquetta Megarry, Editor, "World Yearbook of Education", United Kingdom, in their capacity as consultants to the Secretariat. It will serve as a background report for the Plenary session on Theme 3.

2. The views expressed are those of the authors and do not commit either the Organisation or the national authorities concerned.

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INTRODUCTION

1. This report on the Information Society and General Education integrates data gathered from four sample case studies with ideas from the literature and from other countries, to achieve an overview of current trends in OECD countries. The four were written by OECD experts: namely P. Delmas for France, G. Lariccia for Italy, Tj. Plomp for the Netherlands and J. Megarry for the United Kingdom.

2. The first section of this report indicates the scale of our task. The complexity of the relationships between the Information Society and General Education has been described in an earlier report prepared for the OECD Secretariat (Lariccia, 1983). The second section summarises a selection of the country-by-country studies, grouping them into eight categories. This sets the scene for the general discussion of issues and priorities in the third section.

Chapter I

THE COMPLEXITY OF THE INFORMATION SOCIETY: A CHALLENGE FOR EDUCATION

3. New Information Technologies (NIT) are dramatically changing every facet of our society, challenging the role and functions of our educational systems. It is already commonly accepted that a new kind of literacy is required to live in a world dominated by new information processing tools and media. It is less widely understood that a new kind of knowledge, and perhaps a new type of wisdom, is essential to understand the new educational needs and long-term goals of individuals and nations in the era of NIT.

A. Problems of Growth in the Information Society

4. It is in the nature of NIT that quantitative changes breed qualitative ones. The growth of the new information technologies has been incomparably faster than that of the "old" technologies of the railways, the motor car or the aeroplane. Each of these old technologies has had profound effects on our society; NIT may instead provoke a "quantum leap" proving revolutionary -- not evolutionary -- in their impact.

5. The growth rate in NIT is illustrated by the decrease in the costs of computers. There is a consensus among NIT experts that approximately every two years the computing power available at a given purchase price will double. This pace is likely to be maintained for at least the next 25 years; it is already guaranteed by today's advanced technological research. One expert (Reddy, 1983) considers the use of computers in education against a frame of reference in which by 1990 a $100 computer has the power of today's "supercomputer" Cray-1:

> "I anticipate that we will have an affordable Cray within the next decade: a 100 MIPS (million instructions per second) processor; a million characters of random access memory; and a four million characters of program (read only) memory."

The social consequence of this tremendous acceleration is that most applications that are too expensive today will be affordable tomorrow.

6. What are the social costs and implications of this explosion of

possibilities? Are we prepared to support it with adequate educational policies to improve or maintain our social and civil structures? How can we guarantee to our citizens their civil rights and equality of access to educational and employment opportunities in the NIT society of the future?

7. Access to NIT is constantly becoming easier as computer languages and systems are increasingly designed for first-time users. The result is that, at least in principle, everyone could use computers for storing and retrieving personal information, for writing and editing, and for solving problems in any kind of professional activity. Computers may soon replace pencil and paper both for individuals and large organisations. But what demands does this place on an individual's skills and attitudes? What kind of basic education is required today to allow individuals to make the most of NIT tomorrow?

B. NIT and Human Learning

8. Scientists are starting to investigate how NIT can extend the individual's capacity to think and even to feel. These new capacities are as significant as the advent of printing technologies. Notions of time, space and information are in fact rapidly changing in our culture due to the influence of NIT. Our models of thinking, intelligence, memory, attention, and hence the derived notions of knowledge, learning and teaching are also going to change their meaning:

> "It is known that with rapid changes in technology most of the tools and techniques we learn in school (and college) will be obsolete well before we are ready to retire. Much of what is not obsolete will be either irrelevant or cumbersome for solving problems that arise in day-to-day working life. The only useful part of the education will have been the acquired ability of 'learning-to-learn'." (Reddy, 1983)

9. New models of learning and intelligence are not only derived from the advent of expert systems and knowledge-based systems. Notions of intelligence had already begun to change under the impact of communications technology and computer science. New scientific disciplines like artificial intelligence and robotics provide effective laboratories for the study of the human mind, memory and language. Scientists of a new breed -- half psychologist, half computer scientist -- are casting light on phenomena hardly attacked until 20 years ago. Some of the applications of "cognitive systems" may soon be incorporated in solid state memories, and may produce a dramatic change in the way individuals acquire basic reading, writing and communication skills.

C. NIT and New Ways of Learning

10. Some hint of the potential of NIT for changing the way we learn can be discerned from the examples below, partly borrowed from (Uhlig, 1983). It should be stressed that these are software packages which are already widely available at a very low price on most microcomputers. By comparison with the software of the near future, they are crude and unsophisticated. But already

they show great advances over the pedagogy of the past. Their significance lies in the direction they point towards.

Keyboard Familiarity

11. For many novices, mastering the keyboard presents the first obstacle to computer literacy. Yet the computer can itself be used to teach touch typing far more effectively than a human teacher or typewriter. There are already many software packages which embody elements of "an instructional theorist's dream". Effective instruction is crucial with a highly motivating format including self-pacing, immediate knowledge of results and diagnostic procedures for speed and accuracy.

Word Processing

12. Word processing (WP) software allows the personal computer user to enter words freely without concern for typing errors, to edit (correct and rearrange) those words until satisfied and to store and print perfect copies at will. WP thus transforms the teaching of writing by encouraging students to practise the professional writer's habits of drafting and revising. Since amateur WP users can produce finished work to professional typists' standards, the system also encourages perfectionism in presentation. By separating the stages of entering, editing, formatting and printing, WP emancipates the student's thoughts and words from the labour of production. WP software available on larger microcomputers sometimes includes spelling checkers, grammatical analysers, on-line dictionaries and even an electronic thesaurus. These more sophisticated products have wider implications still for student (and professional) writers.

Foreign Language Learning

13. Language learning is the third example. There are already several pocket translators for learning foreign vocabularies. But there are some features of the new word processors which may soon completely change language learning. Decreasing costs of computer memories has already made it possible to incorporate large dictionaries in personal computers. Within a couple of years, individuals could be learning a foreign language through interactive text editors and translators which incorporate and update models of the users' memory.

14. However, personal computing is by no means the only example of information technology which will affect learning and teaching in the near future. New social relations and patterns of interpersonal communication are being developed by data communication networks. Closed groups, microcomputer clubs and teleconferencing facilities (reviewed in the next section), are already building the foundation for electronic learning communities.

15. The rapid and radical changes just described are not without risk. Firstly, they are not equally accessible to all. Secondly, they are introducing into society a tremendous increase in complexity which may not only exacerbate inequality but may also threaten current educational systems and institutions.

D. Data, Information, Knowledge and Wisdom

16. In one hall of the Capitol's Children's Museum of Washington (described in the next section), there is a passage by Mark Aspen, extending a quotation from T.S. Eliot:

"Where is the wisdom we have lost in knowledge?"

"Where is the knowledge we have lost in information?"

"Where is the information we have lost in data?"

Many problems of the Information Society stem from a failure to distinguish between different kinds of knowledge: there is a hierarchy extending from data through information, to knowledge and to a level above knowledge, which may be called "wisdom".

17. It is obvious that most of the NIT employment opportunities are related to the ever-growing relevance of knowledge of NIT to every kind of work. It is less obvious that data bases and their dissemination contribute to the "knowledge potential" of a nation. It is also clear that the number and quality of expert systems will affect a nation's economic power in the future. It is less easy to identify what the expert systems will fail to provide and what inequalities they will create in educational systems.

18. Knowledge is replacing energy as a basic human resource in almost every kind of economic activity. Capturing and retrieving information depends more and more on data processing and telecommunications technologies. Mastery of these technologies is vital in order to grasp the new opportunities.

E. Risks and Opportunities

19. NIT are transforming learning opportunities. Learning is no longer confined to schools, and it depends less and less on face-to-face teaching. Self-study packages, universities without walls, distance learning through viewdata, teletext and interactive video and self-help through electronic networks are all becoming accessible to more and more individual citizens throughout the world. Distance education is becoming big business for many publishers and manufacturers. The mass media (broadcast and cable television, radio, newspapers, magazines) constantly offer means of self-study and contacts for practical experience. Holiday and leisure organisations are including computer education as an option, and full-time computer camps are available for those who want to combine computer programming with a seaside vacation.

20. New risks accompany the opportunities. Chapter III of this report examines some of the long-term problems posed for governments. Here it is sufficient to cite three of the more specific and immediate risks. First, expertise in NIT demands constant updating and retraining. A Rumpelstiltskin computer expert who fell asleep in the 1960s would be fit only to be a museum curator: he would not recognise the NIT scene if he awoke in the 1980s. But

the hardware of the 1980s is no less rapidly obsolescent and software is still seldom transferable to new generations of equipment. Every five or ten years, an employee may need a completely fresh set of skills to do what is notionally the same job. This requires a continuing investment of resources and energy, both by the employee and employer. It is a process maintained voluntarily by computer hobbyists who meet regularly and engage in mutual informal education. The question is who will pay for this process for people who do not wish to commit their leisure time in this way.

21. The second type of risk could be labelled "the blind technologial imperative". Computer output tends to have an authority more spurious than that of the printed word. Yet computer systems are fallible and sometimes slow. That a task can be performed by computer does not necessarily mean that it should. In some jobs, the human touch may be vital, in others the portability and simplicity of paper or cardboard may be crucial, in others again the nature of the work may be so variable that computerisation is inappropriate. But in the last ten years, many organisations have hastily introduced computers in a mistaken belief that this automaticallly represents an "advance".

22. The third type of risk is related to the conflicts between expectation and reality. Historical accident and market forces have produced a plethora of incompatible products, systems and interfaces. The result is that using and linking systems from different sources often gives rise to complex technical problems, sometimes insoluble without disproportionate expense. This creates a crisis of credibility among "naive" users who expect all problems to be solved at the touch of a button. The discrepancy between advertisers' claims and actual performance is a persistent problem in the personal computer market where first-time buyers often part with their money little knowing what to expect or insist upon.

23. People require counselling and education to evaluate educational products and opportunities just as they need help to evaluate software packages and claims made for hardware. We are all consumers of education, and we need consumer education to guide us towards wise choices. Indeed, the ability to evaluate, select, understand products, goals, means and opportunities is exactly the kind of "wisdom" we need in the Information Society to live with the new information technologies. Spreading wisdom is the key objective in the field of General Education.

F. School Education, Vocational Education, General Education

24. Education should be the "place" where the demand for learning and the provision of effective means are matched. Education must give everybody the chance to explore and master the new opportunities of NIT while also giving balanced consideration to the risks. Different delivery systems are required by the challenge of the information society, establishing specific roles with respect to NIT.

25. The role of school education might be to prepare future citizens to enter the new society. In the domain of information technology, the school's primary role should be to promote good learning habits and thinking strategies

and to build up the fundamental concepts of NIT. Knowledge of the new technology and how to work with it should be secondary to the development of conceptual tools for thinking and learning about it.

26. The role of vocational education should remain more short-term. Clearly-identified groups of individuals need preparation for specific types of job. This entails mastery of the specific competencies and skills required for that job. Although vocational education will largely be concerned with training and retraining of actual and prospective employees, it is essential that skilled performance is based on grasp of fundamental principles. It is also vital that the training and retraining should make the fullest use of the potential of NIT for open learning. Delivery systems might include electronic media, on-the-job training, home-based self-study, tutorial support, peer group self-help and laboratory/workshop "hands-on" experience -- or any combination of these -- in a package which can be tailored to suit individual circumstances. Flexible delivery systems are the enemy of disadvantage. Multi-media provision -- especially interactive video -- offers an exciting alternative for those whose development has been arrested by low levels of print literacy.

27. The role of general education is wider still. It is to provide continuing and lifelong educational chances to everybody who needs them, when and where the need arises, irrespective of age, sex, socio-economic class, geographical location and previous qualifications. It is also to provide a support for surviving the risks of an ever-changing environment. The aim of general education should therefore give everyone open access to understanding.

Chapter II

EIGHT GROUPS OF SAMPLE CASES

28. Some of the cases summarised in this section are derived from the case studies provided by the country experts, others from the literature and from our personal experience. They have been selected on the basis of being capable of abstraction, generalisation or transfer to a different country or system.

29. The examples which follow have been arranged in eight groups along a dimension which combines structure and permanence. The first group of cases include one-off and small-scale events, while the last group consists of permanent and highly structured bodies. Inevitably, the selection is a subjective one, reflecting the interests and values of the authors.

30. In reading the cases, the distinction between the personal domain and the social domain should be borne in mind. Some cases are concerned with helping individuals to come to terms with NIT, others with the needs of organised groups, social and political organisations, businesses and institutions. Keeping abreast of NIT is becoming increasingly important to corporate bodies, which are aware of the threat posed by NIT and seek survival through adaptation.

31. Corporate bodies should profit from the recent history of innovations in this endeavour. Even in state-run enterprises and highly centralised bureaucracies, innovations cannot usually be imposed from the top downwards; attempts to do so are often counterproductive. There must be some incentive for employees to make the innovation work -- and this may require an appeal to their hearts as well as their heads.

A. Computer Camps, Plays, Festival, and Fairs

32. Even for people without previous experience of them, computers have become an attractive and controversial focus for popular events and mass meetings. People seem to seize every opportunity to get "hands-on" experiences. This is for many a preliminary to using, programming or even buying a computer; for others it is a precursor to better understanding of the role of computers in society or at work.

33. The cases below illustrate some different ways of organising these gatherings, with somewhat different objectives. All are aimed at basic familiarisation and are of short duration.

The Club Méditerranée Computer Centres in France

34. The first Club Méditerranée computer centre opened in the summer of 1981 in Kamarina, a Sicilian holiday "village". Since then computer centres have become a major activity in over 42 clubs in various parts of the world, involving over 100 000 people in the first three years.

35. The Kamarina centre offers games, information services, self-study courses and applications software so that participants can familiarise themselves, play, and learn with and about the whole spectrum of NITs. In the first four months of operation 2 500 out of 12 000 participants completed a full self-study course and 1 500 created BASIC programs.

36. The high costs of Kamarina holidays was reflected in the social status of holiday makers -- professional, managerial and business occupations predominated. In July/August only one-quarter of participants were female, with a slightly higher ratio in other months. The composition of the participants is thus determined by market forces and self-selection in response to a commercial initiative. The revelation by the Club Mediterranee of such a large demand has inevitably attracted a flood of manufacturers offering to supply equipment. In effect, these camps offer a huge shop-window to holidaymakers with considerable purchasing power -- both as individuals and through their employment.

37. Before contrasting them with a less commercially motivated movement in the UK, it is instructive to compare some diverse and smaller-scale activities in Italy. These are typical of a less structured approach to general education in NIT.

A Week on New Information Technologies in Foligno (Italy)

38. Umbria is one of the 20 Italian regions with a long-standing tradition in festivals set in beautiful middle-age and renaissance scenarios. In 1982, Foligno hosted a special Week on Informatics which attracted people and resources from all over Italy.

39. The Week was efficiently organised by the "Centro Regionale Umbro Elaborazione Dati" (CRUED), the Umbrian Technical Agency for Data Processing. Several public debates were held on the importance of computer culture in our civilisation, and CRUED demonstrated all the computerised services offered by the regional administration.

40. Special emphasis was given to the educational projects in which Regione Umbria is investing heavily in the next few years; notably the project IDEA to introduce computers in the nursery and primary schools. This will provide the first major field test of the Italian version of LOGO published by Mondadori.

A Computer Play in Milan

41. In December 1983, the first Computer Play, a new kind of conference, was held in Milan. It included the usual public debate on the importance of video and computer games in general education. It also featured a large exhibition of hardware and software on the subject of "games and education". Unlike an ordinary commercial exhibition, many of these exhibits were set up by schools, universities and computer clubs. The Play also included a contest for the best computer game, which produced educational software of very high quality. Around 3 000 people, mostly between 13 and 18, attended.

An Educational Computing Fair in Rome

42. The Educational Computing Fair (ECF) held in Rome in January 1984 was in someways similar to the Milan "Computer Play". It was sponsored by the Department of Education of the District of Rome, and concluded a two-year project in computer literacy which has engaged almost 25 per cent of the senior high school population.

43. ECF had three main components. First, there was a set of five conferences on general problems in New Information Technology and Education. Second, were five "Conferenze Dolci" (literally "soft conferences"). These were offered by young and talented people and included electronic story telling, electronic music, electronic painting, language and science learning and teaching, all illustrated by the live use of computers. Third, there was a set of "poster sessions", at which every participant could demonstrate his/her software on a set of computers provided by the organisation.

Instant Literacy Courses within Commercial Exhibitions

44. Exhibitions and fairs related to computer and information technology products are becoming commonplace in every country. These exhibitions usually have little educational value. Though many of the visitors are novices and want to understand the potential value of NIT in their private and working lives, there is seldom any means of matching their needs with what is on show. All too often, such visitors leave baffled and confused.

45. In an effort to overcome this problem during some of the major Italian fairs, the Italian magazine MC Microcomputer has organised several free two-hour introductory sessions. Roughly one per cent of the visitors attended the courses; the limit was imposed by lack of space and teachers, not by lack of demand.

46. Each participant in the class of 30 had a machine on his or her desk and was able to continue playing around with it after the lesson. A helpful booklet, prepared by the magazine editorial board, accompanied the presentation. Afterwards, some participants expressed their appreciation of the event in letters to the magazine.

47. Considering that such exhibitions attract hundreds of thousands of visitors every year, this example suggests an important method for increasing their general educational value.

INTER-ACTION Community Computer Camps in the United Kingdom

48. The INTER-ACTION Trust Limited is a registered company and charity involved in a great variety of techniques for community self-help. Its strategy is to inject resources and ideas, to provide support during development, and -- once a nationwide network of autonomous local groups is established -- to encourage them to form a federation to sustain the work. The first series of Community Computer Camps was established in London during 1982. Six one-week non-residential camps for eleven to sixteen year olds were offered during the summer holidays. Of these first 224 students, 42 per cent were from inner-city London, and 23 per cent were girls. Two-thirds of the students had no previous experience of programming, but most completed successful projects before they left and 64 per cent wanted to join a computer club to develop their interest.

49. Crucial to the success of the INTER-ACTION Camps is their high ratios of tutors and of computers to students. The fact that these can be combined with low fees (from £20 per week down to £5 per week) is a measure of the organisation's success in attracting subsidy, sponsorship and donations in kind. They also have a flexible approach to recruiting computer studies students as tutors, to using existing spaces made available by local authorities, and to rewarding generous computer manufacturers by publicising their contribution widely.

50. INTER-ACTION aims to establish a nationwide network of 500 camps by 1985 using the same basic model. It has demonstrated its ability to change the usual pattern of under-participation by females, by students of mixed race and by those from inner-city areas by marketing the camps specifically towards these target groups using specialised networks of contacts. The motivation behind Community Computer Camps is three-fold: avoiding waste, redressing under-privilege and building community self-help. The approach is well documented in a practical handbook for those wishing to establish Community Computer Camps.

51. To close this group of cases, here is an ambitious French project mounted with government sponsorship. It is one of many French projects initiated by the Centre Mondial Informatique et Resources Humaine (CMI) whose activities are covered in the eighth group of cases.

"Holidays for the Future" in France

52. In summer 1983, together with several public agencies, CMI launched a major project called "Holidays for the Future" with the personal backing of the Prime Minister. This was the first stage of a large-scale action programme called X2000 which aims to set up 1 000 regional permanent resource centres for NIT. The initial grant was for FF 10 million, supplemented locally by the regional authorities. Almost 400 centres with more than 2 000 Thomson T07 microcomputers all over France were open on average for two months, to generate interest in the new information technologies and to give a wide variety of people the opportunity to handle a computer. Admission was free and enrolment was not generally necessary. Methods of organisation were left open to each centre.

53. The centres were visited by almost 200 000 people, about 40 per cent

from 12 to 18 years old. Interestingly, the project was more successful in the most disadvantaged areas.

54. The computers loaned to the centres were to remain there for the year to be available for social and occupational integration activities by the Ministries of Vocational Training, Leisure and Youth Sports. The municipal authorities also plan to continue the venture by setting up initiation centres for their residents.

55. A noteworthy feature of this project is its multiple use of the same structure and facilities for different purposes, including local government educational projects. It also illustrates collaboration between the public sector and private enterprise, and forms an interesting contrast with the ITeCs covered in the third group of cases.

56. Ultimately the main goal achieved by such a large-scale project is the general raising of awareness. Providing the whole population with easy access to such facilities is a major step toward equalising opportunities.

B. Permanent Centres and Exhibitions

57. Science and technology museums offer a more permanent opportunity for visitors to learn about and participate in information technology.

The Capitol's Children's Museum of Washington

58. This is a clearcut example of action research in general education. The section devoted to computers and communications is incredibly rich in good examples; the new technology is presented in a way that emphasizes continuity with other eras and civilisations.

59. The museum is a private institution, supported by many corporations and institutions. It publishes a good magazine and has a research group in computing which has produced important educational packages.

60. Equipment donated by the Atari corporation enables instant practical courses to be run for visitors who may book in advance from anywhere in the United States.

61. The museum has been designed with a view to the long-term future. Local networks (for data, voice and images) are gradually becoming operational. A satellite station allows broadcasting and reception of other types of information. A powerful computer assists with the booking of groups of visitors and will allow the printing of "instant books" for them to take away after their visit.

The Evoluon of Amsterdam

62. Evoluon is a permanent exhibition of 4 700 square metres which explains technological objects familiar to all of us and tries to convey the role of

science in the ever-changing world. Founded by N. V. Philips in 1966, and financed by the Dutch Philips Company, it is visited every year by 450 000 people and has special facilities for schools. Its scope includes the meaning of technology for society, the importance of life and health, the problems of comfort in and around the house, and issues related to recreation, education, communication and technology for industry. Special presentations focus on computer technology history and applications. The central question which the Evoluon tries to answer for each visitor is "what does technology do for me?"

C. Between the School System and the Job Market

63. Several countries have taken initiatives to prepare the labour market for the advent of NIT. The need for computer awareness for the masses is urgent and demands the services of very large numbers of teachers and tutors. This massive short-term demand creates severe organisational and logistic problems, as once the initial need is met, quite different sorts of manpower and resources may be required. The advent of NIT has created a training need amounting to an emergency; one French project has tackled it with a crash programme in the spirit of national service.

The "Soldiers of Informatics"

64. This project was mounted by the Centre Mondiale Informatique in connection with the "Conference des grandes écoles". Forty young people serving in the French army, with recent degrees in informatics from the most prestigious "grands écoles" have been allowed to spend their national service training unemployed people in NIT. The training was done rigorously, under the direction of a team of specialised teachers, and the soldiers were given extra pay.

65. The thinking behind this initiative is an assumption that the challenge of preparing the rising generation for NIT is comparable to that of the nation's defence. It is a short step to contemplating something like a "draft" if only to meet the most basic educational needs of the nation with respect to NIT.

66. Something of the same urgency can be seen in the rapid establishment of a network of Information Technology Centres (ITeCs) in the UK. These are intended to be a permanent contribution to education and training in NIT.

Information Technology Centres (ITeCs) in the United Kingdom

67. The ITeC initiative was announced in 1981 and a network of 175 centres is expected to be complete by the end of 1984. Interestingly, none of the UK departments of education were involved in their establishment: they represent a joint initiative between the Department of Industry [now the Department of Trade and Industry (DTI)] and the Manpower Services Commission (MSC). The objective of each ITeC is two-fold:

i) To help unemployed young people (especially under 18) to get

vocational experience and training in NIT so as to help them find jobs; and

ii) To establish co-operation with local businesses by developing and producing marketable products and services using NIT.

Although ITeCs vary in their nature, the normal pattern is for sponsoring bodies (local authorities, technology companies and others) to form a special company with liability limited by guarantee.

68. ITeCs normally have 30-40 trainees, attending for between six and twelve months at a time. Trainees are encouraged to seek jobs or full-time education opportunities, and may leave the ITeC course for these reasons. Curriculum guidelines suggest four main activities: electronics, computing, the electronic office and some production activity. Induction training allows trainees to sample these areas before deciding where to specialise. Some assistance is given in developing life and social skills, and there is personal guidance and counselling. On departure, each trainee receives a Leaver's Certificate detailing their work experience, training and further education.

69. The ethos and atmosphere of an ITeC resembles a place of work rather than an educational institution. Although demand often exceeds the supply of places, selection is unlikely to depend on academic qualification and school reports. Some ITeCs use their full-time trainees as tutors for computer literacy courses mounted for participants in the Youth Training Scheme (YTS). Such participation is revenue-earning, since the MSC pays the ITeC to host these courses. It is also a good educational and social challenge for the full-time trainees to have to pass on their newly-acquired skills and competence to the YTS trainees. In effect, the ITeC supervisors operate at one remove, monitoring the quality of the training provided by the full-time ITeC trainees.

70. It is uncommon for the ITeC supervisory staff to have had any previous experience of teaching, let alone to possess a teaching qualification from a college of education or university. This underlines the extent to which the whole ITeC movement has by-passed the normal channels and practices of British education. Despite official ambivalence on the subject, many ITeCs have opened up their facilities to the community, computer clubs and general education: by October 1983 55 per cent had some kind of open access arrangements.

D. A Few Paradigms of Social Integration

71. An important but little-known application of computers is as a means of helping individuals with problems of adjustment to become better integrated into society. This may become a major arena for action research in the next decade. The programming language LOGO is of especial importance in this context. Although LOGO is much more than a tool for special education, its unusual combination of power and friendliness makes it uniquely suitable.

An Introduction to LOGO

72. LOGO is a powerful programming language devised by Seymour Papert of MIT in Boston, Massachusetts (United States). His background combines advanced research on Artificial Intelligence and some philosophical reflection on developmental psychology much in the tradition of Piaget.

73. LOGO embodies a simple syntax (close to that of natural language) with a set of friendly and easy-to-learn "primitive" commands. These give the learner immediate control of some special devices which "inhabit" the world of LOGO. The most famous is known as a Turtle -- a floor robot with a pen for leaving a trail of its movements. LOGO commands allow children to plan an entire course of action for the turtle "as if" they were guiding a blind friend to reach an object in a room. Turtles may also be represented graphically by shapes on the computer screen (screen turtles) controlled in the same way.

74. LOGO's power as a tool for "learning-to-learn" is illustrated by a handful of "powerful ideas" built into the approach. "Guiding the turtle" is one such metaphor, and "teaching the computer" is another. The concept of programming is made as easy to understand as "giving directions" to a friend.

75. In the late 1970s, after some ten years of thorough experimentation with children of different age and socio-economic status, LOGO was made available on several popular microcomputers.

76. The arrival of LOGO on the TI 99/4, APPLE II, ATARI, COMMODORE 64, Sinclair Spectrum and BBC Micro has helped rapid diffusion of this language. Generally each LOGO implementation has been translated into each country's native language so as to provide young learners with a natural learning environment.

77. LOGO is not only a programming language, but also a very stimulating environment in which mistakes are not punished but valued as a necessary step towards learning. Thus "debugging" a programme is a metaphor for the general process by which children's internal models gradually come to correspond with the outside world.

Use of LOGO in a Special Integration Course (Abbaye Association)

78. The Abbaye Association is a non-profit-making association involved in training potential drop-outs and helping to prevent delinquency.

79. In 1982-83 it decided to include computer training to promote social integration, to encourage success and to provide some technical training. It felt that computers help to individualise teaching, that they provide a valuable new communication medium and that they are a natural vehicle for technical training.

80. The power of computers to promote learning-to-learn was expected to combat the recurring failure pattern typical of many educational drop-outs. And by using "soft" technology, they hoped to reduce the alientation induced by technology in the society at large.

81. The project was planned in April 1982 through a set of meetings with Seymour Papert during his stay at OMI. The Abbaye got five APPLEs with LOGO from OMI and started its course with 22 trainees of whom three dropped out after a month. Introducing LOGO required a reorganisation of the timetable and curriculum so that it was integrated into the teaching of all subjects, especially in language work. A "self-service" arrangement gave trainees freedom of choice in pursuing their interests. An evaluation showed wide variation in the mastery achieved: four trainees learned none of the formal aspects of the language, whereas four others learned how to use procedures, edit routines and variables. The project showed that the adaptation was easier for the more isolated individuals than for those more strongly tied to a social group. Abbaye intends to continue with the scheme although it was handicapped by a lack of flexibility in the Ministry of Education's examination arrangements.

Individuals with Learning Disabilities

82. In Italy a national version of LOGO has been prepared on the TI 99/4A computer. This version has allowed experimental treatment of psychological problems with individuals and families by psychologists and family therapists. In one case, a 17-year-old youngster with severe learning disabilities spent a lot of time learning LOGO and prepared his own manual for it in a period of only three months. One striking feature was that his LOGO sessions lasted ten times longer than his habitual span of attention.

The Use of LOGO for Treating Down's Syndrome

83. LOGO has also been appreciated by parents of severely handicapped children. A project for stimulating very young children with Down's syndrome has been initiated by John Heinemann and Maura Cova for the Association of Parents of Down's Children in Italy.

E. The Telematic Connection

84. The opportunities offered by NIT for general education extend far beyond stand-alone microcomputers. Telematics is a general term for information processing and transfer across a distance including viewdata and teletext. Although the application of telematics to general education is still in an experimental stage, the country case studies include a variety of examples with contrasting features.

The Velizy Experiment

85. In this experiment 2 500 families in the Paris area were provided with Minitel terminals giving them free access to videotex services. Videotex is a general term covering passive or one-way communication (teletext) and interactive services (viewdata). Passive services provided news, travel and other information services, whereas the interactive services allowed the user to send messages, order goods, book tickets and participate in computer

assisted learning. The Direction General des Telecommunications (DGT) sponsored research into the personal characteristics of different levels of user. At the outset, all users were given two educational programs and both an electronic and a printed index to the information available.

86. "Heavy users" formed 30 per cent of the total, learned to operate the terminal inside a fortnight, and used a variety of services including the interactive facilities; some called the system every day. By contrast, 25 per cent of the total group never used the terminal at all and wanted to return it. The remaining 45 per cent of "very infrequent" to "medium frequency" users made little use of the interactive facilities and used the system only once or twice a month.

87. Age and sex were strongly linked to participation. Pensioners were usually very infrequent users and youngsters were heavy consumers of games irrespective of their socio-economic status. Females were generally under-represented, but among heavy users they came nearer to equal participation. Socio-economic status was also an important variable, with professionals and white-collar workers dominating the higher use categories, and blue-collar workers frequent among non-users and very infrequent users. One of the main obstacles was the difficulty users perceived in operating the terminal, but another was the lack of relevance of the information that DGT provided. Thus some of the non-users were from business and professional occupations who wanted more specialised information services. Interestingly, some non-users did not return the equipment: the mere possession of the equipment seemed to confer social status.

Microtel -- Ademir

88. The Microtel Club was set up in 1978 as a non-profit association with support from the Post, Telephone and Telegraph (PTT) administration, from the Centre National d'Etude des Telecommunications (CNET), from the Agence de l'Informatique (ADI) and from various public and private agencies.

89. With some 14 000 members and 120 regional clubs, the "Federal National Microtel des Associations et Clubs de Micro-Informatique et Telematique" is now the largest grouping of microcomputer clubs in France. For a moderate annual subscription, a Microtel member receives not only microcomputer software and magazines, but also a large range of special services and opportunities, including the option of borrowing a microcomputer.

90. Local Microtel clubs encourage "understanding" of the potential of computers for individual needs and promote the informal exchange of know-how at any level of competence. Beginners find the clubs valuable for getting rapid and reliable information. Many professionals seem to have been able to find software relevant for their jobs. And the enthusiasts, including some computer specialists, find the exchange of experience rewarding.

91. The Ademir Association is aimed at youngsters under 15, their parents and teachers. At least six teachers are needed to set up a local section, which meets in a local school or college. With 3 500 members and 80 local sections, Ademir has proved effective in promoting computer literacy and the creation and use of educational software. Ademir publishes a newsletter (36,000 Micros) and also offers teachers special courses in computer

applications in education at a fee of FF 1 500 for five days.

92. The experience of Microtel Ademir suggests that computer know-how may diffuse more readily in the "protected" environment of clubs and association. Some kind of "social reward" provides an incentive for people to share their expertise. Information technology is as dependent on its social mileu as are activities like chess and hunting. Access to such informal channels of learning is strongly socially determined, so informal agencies are unlikely to reach large proportions of the population. Because of their flexibility and freedom from government regulation, however, they find it much easier to keep up-to-date than formal channels of state education.

Computer Based Teleconference

93. Computer Based Teleconferencing is very popular in some areas, especially in the United States. This is a sophisticated system for exchanging personal messages held on a large computer. Messages can be directed from every participant to one, some or all of the participants and may be public or private. A conference chairman directs the review and indexing of incoming public messages and acts like the chairman of a face-to-face conference.

94. Teleconferencing is an example of a new social linkage made possible by electronics. Although such facilities tend to seem more costly than telephone and postal services, they are heavily used by their enthusiasts and for some purposes can be both cheap and efficient compared with business travel and conventional conferences. Remembering that a high proportion of telephone calls dialled are unsuccessful in making contact, especially where long-distance connections and different time zones are involved, electronic mail can actually be highly economical. The fact that users can control when they accept messages (rather than being constantly at the mercy of interruptions) is a valuable benefit.

Prestel: The British Lead in Viewdata

95. Prestel was launched by British Telecom in 1978 and was then the world's first public viewdata (interactive videotex) service. Although the potential of such a system was seen to be immense from the beginning, its actual uptake by paying customers has been disappointingly slow, especially among domestic consumers. Compared with the rapid spread of Teletext televisions in British homes, the theoretically more powerful two-way system has been surprisingly slow to catch on. Part of the explanation lies in the costs: once you have bought a Teletext television (about £100 additional cost) the running costs of Teletext are effectively zero, so there is every incentive to make use of the information services. Prestel's running costs, on the other hand, are considerable: you pay for telephone connection time, for computer time and also for individual frames. The total varies according to the time of day, and the distance from the Prestel computers and the decisions made by Information Providers: excluding frame charges, a subscriber might pay anywhere from £0.66 per hour to £15.90 per hour.

96. Over 230 000 pages of information were available by 1983, provided by over 1 000 Information Providers. Around 50 per cent of Prestel business was

accounted for by the top ten Information Providers, who include major sources like British Rail with over 13 000 pages. This perhaps reflects the predominance of business users (notably travel agents and tour operators). Although Prestel's initial policy was to provide a general information service, and to act as a "common carrier", there has been a marked trend towards provision of specialised and private information services. Notably among the recent growth areas have been Closed User Groups (CUG) and Gateway. CUG provide Prestel users with a confidential information network within Prestel, including electronic mail between different locations and a hierarchy of access arrangements for different categories of users within the Group. Gateway is a facility whereby the Prestel user can make direct contact with an external computer, for example allowing a salesman to interrogate the mainframe at his company's headquarters, or a traveller to access realtime information from an airport departures board. The growth of services like these and the importance of the direct marketing potential underlines the extent to which Prestel has been responding to the needs of business.

97. Clearly the Prestel data base contains an immense amount of information and represents a major educational resource both in itself and for the lesson it illustrates in information handling. It has a potential role in the teaching of information technology, social studies, business studies and economics and a major Council for Educational Technology project has investigated its scope both as an educational resource and as a mechanism for delivering telesoftware. (However, one CET project teacher noted that his school had surprisingly little use for up-to-the-minute information.) CET found great enthusiasm for local viewdata software systems, which proved both valuable and cost-effective, not only for teaching about Prestel, but also as a project in collaborative knowledge building for teachers and pupils, with applications ranging from electronic magazines to the design of crisis simulations.

Micronet 800

98. Micronet is potentially the most successful example of a CUG within Prestel. It attracted more than 5 000 subscribers in its first seven months of operation. By contrast, Prestel attracted only 26 268 users in its first five years. The Micronet annual subscription of £52 gives full access to Prestel and an additional 20 000 Micronet pages which include free software ready for downloading into commonly available microcomputers.

99. About 100 free programs for the most popular makes of micros were promised for the first year of operation, and this collection was to be changed on a regular basis. In practice these promises proved over-optimistic. It is unquestionably the lure of free software that has tempted many subscribers into the Micronet club. Opinions differ about the quality of the free software, but Micronet undoubtedly represents a cheap means of accessing Prestel services for microcomputer owners.

100. Furthermore, Micronet subscribers can download commercial packages at a worthwhile discount compared with shop/mail order prices. The telesoftware mechanism is also faster and more reliable than conventional shopping for a disk or cassette which may prove faulty.

101. Insofar as Micronet encourages its subscribers to contact each other

and to influence its management by sending electronic messages, it may develop greater significance for general education. If enough subscribers join forces within Micronet, they could establish an influential electronic community with strong mutual communications capable of bringing real pressure to bear upon publishers, broadcasters, manufacturers and Information Providers. However, Micronet is a commercial enterprise at present confined to a sub-set of a privileged population of British microcomputer owners. Its growth, although rapid, is too recent to project reliably, and its overall strategy not yet clear.

F. General Education within the School System

102. This theme is almost outside the scope of our report as it is covered by other OECD reports. But developments within the school system affect the latent resources available to general education, and conversely, the rapid changes in the world outside school have caused some governments to mount major programmes to help the school system to adapt. Two important examples exist in the United Kingdom: the Microelectronics Education Programme (MEP) and the Micros in Schools Project at the Open University.

The Microelectronics Education Programme (MEP)

103. MEP is a government-funded programme which aims "to help schools prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive." It was announced in March 1980 with a budget of £8 million to spend over 1981-84 and a remit to cover schools in England, Wales and Northern Ireland; Scotland is covered by a separate programme. The extension of MEP funding to £20 million was announced during 1983.

104. Decentralising control has always been an aim of Director Richard Fothergill's strategy. From the very start, MEP's whole approach has been to work through Regional Information Centres (RICs) in partnership with groupings of local education authorities. Inevitably, the 14 RICs vary in the strengths and weaknesses of their staff, the accessibility and opening hours of their premises, the emphasis they give to different aspects of MEP's aims and their effectiveness in disseminating information about their activities. MEP thus seems to take on a subtly different identity in different parts of the country depending on the RIC in question.

105. In order to maximise the impact of funding which, although major, has to be applied to a school population approaching 10 million, MEP has pursued a policy of working through other agencies: commercial software publishers, companies like British Petroleum (BP), International Business Machines (IBM), Standard Telephones and Cables (STC) and public organisations like the British Broadcasting Corporation and the Open University (see below). The success of this policy is illustrated both by the quantity of resources it has sponsored -- print, audiovisual, software, firmware and hardware -- and by their quality. The policy also means that many other agencies have a vested interest in the development and marketing of these resources. This guarantees their future and makes them independent of the vagaries of central government funding.

106. MEP was planned for a Britain in which microcoputers were just beginning to spread in secondary schools and were virtually unknown in primary schools. During 1981-84 various 50 per cent subsidy schemes were offered by the Department of Industry (now the Department of Economics and Industry) to stimulate the purchase of British micros and peripherals. These rapidly transformed the picture so that by 1984, every British primary school had at least one microcomputer and secondary schools had an average of four. This enormously increased the pressure on MEP resources and led to the setting-up of an MEP National Primary Project in 1983. Furthermore, although MEP's remit did not include post-school education, demand has been such that the DES Further Education Unit circulated an annotated directory of suitable MEP material in 1984.

107. In addition, MEP has undoubtedly influenced what is available on the domestic market: pressures on educationally aspirant parents are cleverly exploited by advertisers. Sinclair has successfully marketed its Spectrum together with "the same software that the government approves for use in schools", and the Acorn Electron has been advertised for its ability to run MEP software. Again, various battery-operated devices sold as toys on the domestic market have acquired educational respectability as a direct result of MEP-funded curriculum development projects and associated books: for example Bit Trak, a Milton Bradley programmable robot vehicle, and the Texas Instruments hand-held Speak & Maths and Speak & Spell.

108. Both within the formal education sector and outside it, then, MEP has been under constant pressure to expand its role and services from the very beginning. In spite of this, it gave serious thought to working out a strategy for maximising its impact and resisted the demands from various quarters that it should produce early results at all costs. The first year of MEP's operation was marked by considerable criticism, much of it ill-informed and premature. Nevertheless, the Directorate stuck to its strategy even though it was bound to require an apparently "fallow" period while delicate negotiations were undertaken and the seeds of long-term collaboration sown.

109. By mid-1983 the patient negotiation and preparatory work was beginning to pay off, as the first MEP Resources Catalogue demonstrated. In addition to a wide range of MEP-sponsored software and hardware was an extensive list of audiovisual resources: BBC radio programmes, tape/slide programmes on telesoftware in education and modular control, 20 videotapes and various classroom case studies on audiotape. The second edition (published by Tecmedia in Spring 1984) testifies to further progress and diversification.

110. A notable feature of MEP has been the strength and success of its in-service training programme. The "cascade" model of training was to create a first wave of trained teachers who were then able to offer familiarisation courses in the regions to further teachers, who in their turn could initiate courses for others in their schools, using a multiplier effect to reach ever-increasing numbers. This was combined with the use of distance learning materials like the Microprimer pack (combining print, software and audiovisual resources) in order to meet the challenge of the simultaneous training needs of a whole generation of primary school teachers. This approach to the problem of accelerating and multiplying the impact of traditional in-service training has attracted worldwide interest.

The Open University and the Micros in Schools Project

111. Britain's Open University (OU) is a major resource for general education in NIT. It is best known as a provider of higher education at a distance: most of its 65 000 students are adults with jobs or other full-time commitments studying for degrees. However, a commitment to continuing education was written into the OU's Royal Charter, and by 1983, it offered a wide variety of short and introductory courses, specialised courses for industry and "post-experience" courses aimed at teachers and other groups. By late 1983, the OU was involved in some 20 major projects concerning computers and general education.

112. The Micros in Schools Project is primarily aimed at teachers. Of its £1 million budget, around half has been borrowed against future sales and half has been provided by MEP. The Project is to produce five packs: Awareness, Educational Software (P541), Micros in Action in the Classroom (P542), Microelectronics (P543) and Microcomputers (P544). The first three all emphasize educational software; their purpose is to make the teacher an intelligent consumer, aware of what is available and capable of making judgements about its suitability. The latter two packs include DESMOND, a battery-powered electronics kit, and incorporate extensive practical work.

113. A team of four full-time programmers/analysts are producing software for five microcomputer systems: the BBC Model B, Sinclair Spectrum, Apple II and the two Research Machines (380Z and 480Z). Around 75 per cent of the material is general, 25 per cent machine-specific. The Awareness Pack appeared first: it consisted of three booklets (a Study Book, a Project Book and Case Studies) and software cassettes (containing four programs).

114. The Case Studies booklet contains 13 portraits showing how computers are actually being used in classrooms. The style is vivid and the selection of examples varied. Unfortunately, some of the most interesting applications use hardware and software which is not yet widely available, but the booklet is an excellent resource for helping to enlarge people's thinking about how computers might be used.

115. The Project Book is essentially a guide to the software, though it also contains a guide to evaluating software and a good glossary. Four programs are supplied: EUREKA, TURTLE, INTEREST and SERVICE. EUREKA shows graphics of a man having a bath. The user controls the bath taps, plug and his movements in and out of the bath, and can plot a graph of the water level. The program can be used as an electronic blackboard, a simulation or to pose a detective-style mystery. TURTLE gives the user access to the LOGO programming language (see section D). Although it is only a partial implementation of LOGO graphics, this provides an easy introduction to programming in a high-level language.

116. INTEREST is a program-within-a-program, designed to show the operation of counters and loops in slow motion during the step-by-step execution of a simple BASIC program. Users "walk through" the 10-line program at their own pace, and see how it calculates compound interest. Meanwhile the program is displayed together with the current values of all its variables. Finally, SERVICE is a queueing simulation set in a fast-food take-away restaurant, with graphic display. The user can vary parameters like the number of helpers and length and timing of their rest-breaks, and discover the effect on waiting

time, customer satisfaction and profitability. Apart from the obvious application to business studies, the exercise illustrates the uses and limitations of computers for simulating real-world events.

117. Overall, the Awareness pack sets a high standard of presentation and provides some interesting material. It does not substitute for the sort of practical training provided by MEP's in-service packs, nor does it help its users with mundane but vital computer skills like disc handling or formatting. It does, however, successfully concentrate on positive thinking about the contribution of computers to education.

G. Computer Literacy for a General Audience: the BBC Projects

118. The BBC Computer Literacy Project was launched in 1982 by the Continuing Education Department of the British Broadcasting Corporation. It was a complex project on a vast scale with a target audience of millions, if not tens of millions. The main element of the first phase was a series of ten television programmes, the commissioning of a microcomputer from Acorn Computers Ltd., a self-study course devised by the National Extension College (NEC) and supported by tutors and study groups operating through local centres, and the Computer Referral Service which puts members of the public in touch with over 1 000 local sources of help. General support and advice was given by the Microelectronics Education Programme whose Regional Information Centres were involved from the beginning.

119. Various materials were published in conjunction with the Project -- notably two books which have both sold over 100 000 copies: The Computer Book (BBC Publications, 1982) is a well-illustrated and readable introduction to the whole field and Thirty Hour BASIC (NEC, 1982) is a self-study programming course. BBC Publications also published software associated with the television broadcasts, and its teletext service CEEFAX broadcasts telesoftware to those who bought the teletext decoder unit (released in 1983 at £200).

120. The Project's main aim is to demystify computers by building understanding through practical experience. It was realised through a complex web of collaborations with organisations of different kinds: thus the BBC (a state-owned corporation) enlisted a private enterprise (Acorn Computers Ltd.), a non-profit-making trust company (NEC), an independent educational charity (Broadcasting Support Services) and a government-funded agency (MEP).

121. The first series of ten TV programmes (The Computer Programme) provided a general introduction to the hardware, software and applications, with simple illustrations of BASIC programming built into each programme. The presenter, Chris Serle, represented the layman with no previous knowledge or experience, being guided through the various obstacles by a computer expert. Studio sequences were illustrated with screen shots and captions, interspersed with films sequences of real-world applications from the corner shop to international airlines. About 1 million people watched each programme and about 7 million saw some part of the series first time around. Generally, it was well-received, although an appetite for greater detail was evident among parts of the audience.

122. The Computer Programme series was first transmitted in January 1982 and was soon repeated in the UK; it has since been networked in the United States, Australia, New Zealand and several countries in Asia and Europe. The follow-up series (Making the Most of the Micro) was aimed at "users or potential owners" of microcomputers and also at "a general audience of the technically curious". It was first transmitted in January 1983 and quickly built up a total weekly audience of around 3 million viewers. It was widely used in recorded form by schools and colleges. The second series assumed some familiarity among viewers and looked in more detail at topics like string handling, graphics, data bases, control and business applications. Subsequent series have included Computers in Control and The Electronic Office.

123. Perhaps the most controversial feature of the Project was the BBC's decision to commission its own Micro. The rationale was the perceived need for a machine of British design and manufacture, easily expandable and relatively "future-proof", with a good keyboard (adequate for word processing), capable of sound, colour and "high resolution" graphics, and with a resident dialect of BASIC which combined as much compatibility as possible with previous BASICs with the ability to support powerful extensions. Apart from those critics who are opposed to any dialect of BASIC on principle, most people find BBC BASIC surprisingly powerful and flexible. Other languages such as LOGO, MicroPROLOG and Microtext are rapidly becoming available.

124. Now that the technical and production problems which dogged its first year have been overcome, the BBC Micro has been widely adopted by the British educational establishment. Growing amounts of commercial and MEP-sponsored software and training materials have been published. This support has tended to accelerate exports, especially to the English-speaking world. A consensus view might be that it is a well-designed machine, with a question-mark in some minds over supplies, dealer support and reliability. Sales approaching 250 000 were reported by Spring 1984.

125. There has been a variety of follow-on projects mounted by different departments of the BBC. 1985 will see the launch of a follow-up project with broader scope, covering the whole field of information technology. Called For Your Information, it includes an illustrated BBC Publications book, specially designed software, a radio series to be broadcast in Spring 1985 and a new syllabus created by the City and Guilds to provide certification for anyone participating in the project.

H. Some Examples of Permanent Structures

126. This section describes two relevant permanent structures, one from France and one from Italy.

Centre Mondial Informatique

127. The Centre Mondial Informatique et Ressources Humaines is the realisation of a very ambitious project conceived in the late seventies by an economist interested in reducing the gap between industrialised and developing

countries through the use of electronics and informatics.

128. The Centre was able to attract several international scientists. Although some of the international staff were able fully to accept with the growing needs of the French nation for NIT literacy, most of the CMI projects still carry a great concern for a humanistic view of technology.

129. CMI serves at least three different functions with different operational strategies. The first, visible to visitors to the Avenue Matignon, is an open space filled with microcomputers of various kinds. This is aimed at casual visitors but is also available for schools and organised groups wanting to pursue more structured objectives. In this way CMI serves the same functions as the Capitol's Children's Museum on a smaller scale. The second function of CMI is to carry out advanced research on educational technologies of the future, such as interactive videodisk. Thirdly, CMI promotes large-scale projects in NIT jointly with other national and international agencies. This role has already emerged in earlier sections of this report.

130. CMI started its operation in 1981 with an annual budget of some FF 100 000 and a permanent staff of more than 50. Its short-term objectives of promoting literacy through NIT projects are well integrated with long-term ones. CMI represents the first deliberate attempt to set up an international research and development Centre on general education in NIT. Maintaining a balance between urgent domestic needs and long-term international objectives is a perennial problem. CMI's partial failure to achieve fully-fledged international status only underlines the question for other countries: how far can and should CMI's research be replicated elsewhere?

FORMEZ: An Italian Adult Education Agency

131. FORMEZ is funded to promote educational projects to promote economic development of the south of Italy; it is also the biggest public agency for adult education in Italy. It sets high standards both for its staff and in the quality of its products which are disseminated through other agencies in Italy.

132. With an annual budget of some $20 billion, FORMEZ has produced many relevant educational packages in the field of general education. For example, ELEC is an audiovisual introductory course (ELementary EConomy), and there is a multimedia course in general education for adults with interesting modules on anthropology, science education, public administration, commerce, and international relations. Schools and non-profitmaking cultural organisations located in the south of Italy are entitled to get copies of FORMEZ educational products at a nominal price.

133. FORMEZ has a structure of nearly 200 Adult Education Centres (AES) throughout the south of Italy which are open to everybody who wishes to consult the multimedia library. Every year the AECs organise a comprehensive set of conferences. Special courses related to major FORMEZ products are held for selected groups of young adults, often in connection with their change of status in the labour market.

134. Many FORMEZ projects already combine different media and educational strategies effectively. Not surprisingly, FORMEZ intends to invest in new

information technologies both as a medium and as a goal within general education.

135. At the level of general understanding, FORMEZ planned a new edition of a very successful audiovisual course, the "Corso di Cultura Generale per Adulti" (General Education for Adults or GEA) with a considerable emphasis on information science and technology.

136. The audiovisual version of the course was to be finished by the end of 1984 and was to contain sections on knowledge, science, common sense; communication; computer science; and information storage and dissemination.

137. A computer-based version of some FORMEZ audiovisual packages in MicroPLATO is being developed jointly by SISCO, Control Data Corporation and SYNTAX, an Olivetti-owned research company. Other plans include the use of a more sophisticated integrated workstation with a videodisc-based catalogue of educational products, to be used in the AECs for self-study and course planning.

138. The educational philosophy underlying most FORMEZ packages is taken from Dewey and Montessori. Thus the GEA course starts from common sense and everyday experience and leads on to alternative interpretations of the evidence. New knowledge is accommodated through active learning methods, not by passive reception. The educational material is primarily intended as a stimulus to discussion and the exchange of views. The GEA package does not intend to promote mere acquisition of knowledge about the information society, but a deeper understanding of its implications.

139. GEA courses are run for groups of 20 young people with a tutor. The classes are open to everyone aged 15 and upward; no formal qualifications are required. Some will be unemployed, others in jobs. The courses are not intended as vocational education nor are they linked to the school curriculum. They are a major contribution to general education for adults in the information society.

Chapter III

NIT AND GENERAL EDUCATION: THE ISSUES

140. In Chapter I we discussed NIT's potential for enhancing human learning. New methods and delivery systems which capitalise on NIT can bring education within the grasp of people who were previously disadvantaged by age, circumstances, distance or other handicaps. This immense potential for innovation is combined with a profound challenge to the assumptions, practice and even institutions which prevail in formal education. We begin by identifying some aspects of that challenge.

A. NIT and Formal Education: The Challenge

Curriculum

141. NIT underlines the rapid obsolescence of any kind of curriculum. In fact NIT may even question the very importance of a curriculum such as it stands now. The definition and "implementation" of a new curriculum requires nowadays a very large amount of time and resources. By the time a new curriculum is conceived and formally approved and begins to be "implemented" in the educational system, it is very likely to be already obsolete.

142. Vested interests in teaching particular subjects obstruct attempts to bring the school curriculum into the 20th century. Even in subjects as recent and as rapidly-evolving as computing, teachers seem inclined to teach their subject from its historical beginnings, so that content accumulates at the price of mastery of method. The commitment to teaching discrete subjects in secondary schools is one of the obstacles to the establishment of NIT both because of the problem of identifying what is to be displaced and because the impact of NIT is (or ought to be) felt across the board.

Methods

143. Traditional teacher-centred class teaching methods contrast unfavourably with possibilities revealed by NIT, both in their ability to cope with individual differences and in their appeal to the students. Already highly motivating use of colour, animation and sound effects can be combined with individual interaction, diagnostic feedback on errors and management of

progressive difficulty levels. Although much "educational" software has failed to capitalise on these possibilities, software publishing is in its infancy and improvements can be expected. In the near future, affordable interactive video will offer all the realism of live sound and movement combined with the individual responsiveness of the computer. Also imminent is the diffusion of software embodying expert systems with intelligent language handling: the Socratic dream of having an expert tutor to oneself, able to converse in natural language, cannnot be far away.

Delivery Systems

144. Traditionally, formal education has been delivered during fixed hours, in pre-determined places, with courses beginning in fixed months of the year. Previous qualifications are sometimes demanded, and there may be age restrictions. NIT calls all of this inflexibility into question. Given suitable equipment -- e.g., a cheap microcomputer, standard television, telephone and modem -- there need be no artificial barriers to learning. Why should not the elderly, the disabled, those in ships or prisons, people on remote islands and mothers housebound by infants all have access to the same courses and examinations as the stereotype of the 18-year-old mobile bachelor for whom residential university education is traditionally designed? Naturally, some educational objectives require attendance at some kind of local centre, whether to gain access to specialised equipment, for face-to-face interaction with other students or the tutor or because home conditions make serious study difficult or impossible. But once the possibilities of NIT have been fully understood, it is remarkable how few of the conventional restrictions can be defended rationally, and what a high proportion of needs can be accomodated on a flexible basis offering more convenience to students.

Teacher Training

145. NIT has created a crisis of credibility for teachers of practical subjects without recent business or industrial experience. To take a single example, there are still teachers of secretarial studies teaching shorthand to pupils who will emerge into a job-market where even dictation equipment is being superseded by voice-entry word processors. More generally, there is an acute problem of how to update and retrain entire generations of school-teachers whose initial training excluded any mention of computers. The United Kingdom Microelectronics Education Programme has successfully demonstrated the promise of high-quality distance learning materials for a crash programme of in-service training. Even so, there is a large gap between the teacher whose experience is confined to a short self-study course and the calm confidence of the experienced home computer user. Remembering that the latter may be seven years old and the former paid to teach him or her, it is easy to see why so many teachers view NIT with apprehension.

146. The initial training of teachers presents an equally pressing problem; teacher trainers are sometimes even less familiar with NIT in modern business and industry than the student teachers they are expected to train. The general contraction in teacher education has reduced the influx of new blood, and inducements to early retirement have meant the loss of many lecturers with outside interests and an entrepreneurial flair. Nevertheless, any programme

for re-educating teacher trainers depends on motivation and consent for its success. If it is imposed from "on high" it is bound to fail.

147. Teachers' and teacher trainers' desire to learn about NIT is re-inforced by the knowledge that if they do not adapt, they will be by-passed. If it really takes 50 years for a suggested innovation in teacher education to turn itself into classroom practice, then alternative means must be found, because in another 50 years NIT will be unrecognisably different. Some straws in the wind were documented in the case studies: Delmas reported that in the case of the "Holidays for the Future", often the least well-trained instructors were the most enthusiastically accepted. He also described the growth of the twilight world of unofficial clubs where peer learning/teaching is the norm, with small advertisements and informal networks replacing the apparatus of formal schooling. Megarry commented upon the significance of the massive government ITeC initiative having by-passed the formal education sector and using staff who would not be acceptable within the school system. Recent observers have pointed towards a trend towards deprofessionalisation of the traditional white-collar careers; NIT may hasten the process within teaching. Its sheer urgency underlines the difficulties that the education system has in accomodating rapid change.

Education and the Life Cycle

148. Formal education has hitherto been committed to the "front-end model" of administering a single dose of education early on in a person's life, after which that person is apparently considered "educated". Apart from the obsolesence of the knowledge available, it is increasingly obvious that adolescence is not the only, and probably not the best, time in a person's life to offer educational opportunities.

149. Information science emphasizes the need for lifelong learning (education permanente) as well as providing appropriate methods for obtaining it. The problem of information overload provides a telling argument against the front-end model of education. For example, the number of scientific journals published has grown exponentially -- from two in the mid-17th century to 100 in the mid-18th to 1 000 in the mid-19th century. Nowadays between 30 000 and 100 000 are published -- 6 000 to 7 000 scientific articles each day. As Morgenstern remarked, if the publications on physics were to continue to increase at their present rate, within the next 150 years the total weight of the paper would exceed that of the earth! Clearly it is no longer possible for any individual to master all aspects of a subject within a single lifetime. Instead we must accept the idea that updating knowledge is a permanent requirement, and harness the power of NIT to help us locate and process information when we need it, e.g. using on-line data base searches and expert systems.

Effects of the Job Market

150. The employment market is contracting and changing its nature, reinforcing the case for education continuing throughout adult life and for transforming the relationship between general and vocational education. In a world of obsolescent skills and industries, with microelectronics and NIT affecting job content and the exercise of traditional skills, there is clearly

no longer any role for narrow job-related training in schools. Instead, education must prepare pupils for a society where vocational retraining and career changes are the norm, where self-employment, freelance work and job-sharing are commoner, and where mass structural unemployment may continue to take its toll of human misery and indignity.

151. For the pessimist, "education for leisure" conjures an Orwellian image of masses of people turned into passive recipients of NIT services and products, mindlessly hooked on home entertainment provided by extended television/videotex/interactive cable services. A more optimistic view recognises that the boundaries between leisure activity, education for self-improvement, voluntary (unpaid) work and economic activity are all socially defined. At present, creating and using computer software may fall into any of these categories for different people -- or even for the same person at different times. If automation, robotics and NIT create sufficient wealth, new consumer demands and leisure/education industries will continue to create opportunities for part of the population to consume goods and services provided by another part. We may all become consumers of leisure/education for far higher proportions of our day/week/year/lifetime than hitherto.

152. Suppose that by the 21st century, many citizens in OECD countries can support themselves comfortably by working for (say) 480 hours a year. Whether this is arranged as 12 working weeks of 40 hours each or 48 weeks of 10 hours each, it clearly will present unprecedented opportunities to make productive use of the remaining waking hours. The time could be used to learn woodworking or a musical instrument, to teach a friend to grow plants or cook, to enrol for a recognised qualification in small boat navigation, to write letters to friends or articles for publication, or in caring for young children and helping them to learn. In some of these, NIT will have a crucial role, in others it might be almost irrelevant. The challenge for educators is how to ensure that NIT increases the individual's autonomy and self-directedness, rather than simply providing mass "entertainment" in a wired society.

153. In the light of all of this, it cannot be assumed that schooling (in the sense we understand it today) will survive indefinitely. It is too soon to predict what form the alternatives may take. Some clear thinking about what educational processes do and do not require physical proximity is urgently needed. However, it is not our purpose to bury the school prematurely. The elements of compulsion and universality play a crucial role in redressing the different kinds of inequality addressed in the next section.

B. NIT, Equality and Disadvantage

Sex

154. Throughout the case studies, a recurring theme was the underachievement and underparticipation of females of all ages in NIT. This is further documented in the World Yearbook of Education 1984: Women and Education (Kogan Page, 1984). Women's traditional skills of patience, dexterity and accuracy mean that they dominate low-paid NIT jobs like data preparation, word processing and telephone switchboard operation, but they have made

surprisingly small inroads into computer programming, systems analysis and software design. Whenever female aptitude for such jobs is tested, it is found to be at least equal to that of males. So the explanation of imbalance is not unequal ability.

155. During the years of impressionable adolescence, girls struggling to achieve a sense of feminine identity have to make choices (often perceived as irrevocable) about subjects to study and courses to pursue. Computers have an image influenced by their history of "male" concerns: wartime code-breaking, the space race, big business and high-technology industry. Computer games sold for "entertainment" display a depressing preoccupation with warfare and destruction. Whether this merely reflects or actively reinforces the interests of their purchasers, the combined effect is that computing has a strongly masculine image. This is reinforced in young minds by the tendency of men to be the ones who own, use and teach others how to use computers. None of this is inevitable: Megarry described how the INTER-ACTION Community Camps managed to reverse the usual sex ratio by deliberate marketing decisions. But this does require a conscious effort: thoughtlessness probably contributes more to sex-stereotyping than does outright prejudice.

156. Most developed countries are very short of talented NIT workers. Given the enormous industrial and strategic importance of this field, with massive government investment and keen international competition, it does seem wasteful to discourage (however unintentionally) the participation of half the nation in this way. The spread of microcomputers into primary schools (where they are operated mainly by female teachers) should help to dissolve the current association in young minds. Widespread adoption of creative and open-ended software in the arts and humanities would also help to dissociate computers from the mathematics and science departments of secondary schools. Making computers and NIT an integral mainstream part of the compulsory curriculum would help to prevent girls from opting out, but where the computer club is optional, self-selection will militate against equal female participation.

157. Special thought must be given to the problems that once-qualified women encounter when trying to re-enter the job market after a gap of some years, usually caused by the assumption that women must interrupt their careers for domestic reasons. No field could be more forbidding to the re-entrant than NIT: an absence of even three years may be equivalent to several decades in other occupations. A general expansion of retraining opportunities would help. In the longer-term, the development of more flexible ways of combining infant and child care with part-time employment of "permanent" status could remove the necessity for women to lose contact with the NIT field. After all, computer literacy can be of immediate benefit to a baby's mother: simple programs can create fascinating interactive screen displays with far more educational value than passive viewing of a television screen!

Age

158. It is widely assumed that NIT belong to youth. There may be, in fact, some valid reasons to explain why young people are more attracted by some motor, perceptual or even intellectual mechanisms in a way that is never parallelled later on. In fact the motor control of fingers on the keyboard and of the eye movements on the screen may be greater at a younger age than

in later life. Perhaps even the ability to analyse and recognise complex visual patterns on the screen is greater at a young age, thus enabling young people to master more rapidly and efficiently graphics, animation and concurrent phenomena.

159. The natural inclination to play games and lesser concern for the management of personal resources (including time) are perhaps other reasons that may provide a good explanation of this supposedly strong relationship between youth and computers. The ability to master large bodies of organised knowledge and to allocate personal resources to meaningful objectives, however, is probably far greater in adults than in children.

160. We do not have enough evidence to prove that the relationship between young people and NIT is significantly stronger, but we should investigate, on the other hand, whether this supposed relationship does not hide any intention to exploit an ample and low-cost manpower resource. It is already only too common to find young and talented programmers being hired for next to nothing, or to be used without being paid for software demonstrations for commercial reasons.

161. It should perhaps also be investigated whether the ample and ever-growing market of commercial education in the field of NIT does not hide a large business and at the same time the idea of lowering the cost of manpower by creating an artificial surplus of programming skills.

162. There is ample evidence that adults have and retain the ability to learn new skills and concepts, including mastering whole new bodies of knowledge to a high level, well into what has been regarded as "old age". The fact that mathematicians are unlikely to do their most original work past the age of 30 is as irrelevant to the lives of ordinary people as is the observation that women are unlikely to win Nobel prizes for science.

163. The reasons why older people are less likely to embrace NIT are similarly historical, cultural and sociological, rather than biological or inevitable. The increasing proportion of the population above the official retirement age may bring about a re-examination of the attitude barriers which associate youth with NIT. Learning practical computing is above all time-consuming, and many senior citizens have time on their hands. Delmas remarked that some of the heaviest videotext users in the Velizy experiment were pensioners. Given the opportunity and the incentive, "retired" people's wealth of experience of human beings and organisations could make their contribution to NIT particularly valuable.

Money

164. It is difficult to generalise about the importance of money as an obstacle to equality. There is no doubt that possession of a home computer system breeds confidence in computer users which confers upon them a massive advantage in acquiring competence. The greatest thing to fear in learning about NIT is fear itself. The opportunity to experiment and make mistakes in the privacy of one's own home is a great confidence-builder, and it follows that children from computer-owning homes are at an "unfair" advantage. (It is interesting that several large firms and education authorities wanting to

spread computer literacy among executives and teachers have recognised this by a deliberate policy of home loans.)

165. How expensive -- and how unfair -- is this advantage? In Britain, it is estimated that 11 per cent of homes will have at least one computer by the end of 1984. If you already have a television and a cassette recorder, serious home computing may begin at around £130 (the price of a new 48 K Sinclair Spectrum) or less; this is around the national average weekly wage. If you already have a telephone, access to interactive videotex (Prestel) costs another £100 for the modem (excluding running costs). Making effective use of all this is another story. Serious programming demands a printer, faster external memory than a cassette recorder provides, a monitor so that the computer user is not dependant on time-sharing the family television, a permanent set-up with the furniture and space to accomodate it, not to mention software, paper and blank tapes and disks. Word processing demands a proper moving-key keyboard and may invite a better-quality printer. From £1 000 to £1 500 would be more realistic for a working personal computer system at 1984 United Kingdom prices. Thus computers may be cheap but computing is still expensive.

166. Even so, many British families will spend more than £1 000 on the annual family holiday, and sometimes much more on a new car. The word "expensive" says as much about the purchaser's attitude as it does about price. Middle-class families are more likely to see a home computer as an investment in the future, the 1980s equivalent of a children's encyclopaedia, and perhaps also to imagine that they will learn to program it "some day". Advertisers have not been slow to exploit middle-class anxiety that their children may be "left behind". Some of the micros bought in this spirit are never used, the parents having seriously underestimated their children's interest or the time and energy required to produce worthwhile results. Nevertheless, there is no doubt that children whose parents are able and willing to afford a home computer are at a significant advantage. How far and by what means should the state try to redress the disadvantage of those who cannot expect this facility in their homes?

Social Class

167. The extent to which higher socio-economic groups tend to predominate in NIT initiatives is in many ways a paradox. After all, the alienation of working-class children from formal education is often explained in terms of an academic curriculum deriving historically from upper-class culture and a teaching force that embodies middle-class values, attitudes and language habits. By contrast, micros employ the archetypal symbol of mass culture: the television. Computer games often resemble electronic fruit machines and space invaders. Because computers involve people in practical activity, they offer ways of making abstract concepts like syntax, logical deductions and geometry into concrete events like the failure of a program, a screenful of garbage or the movement of a Turtle. Thus, the argument runs, the working-class child ought to feel more at home with computers than with books, and the relentless logic of the computer should combat any tendency among middle-class teachers to confuse refined speech or elaborate verbosity with ability.

168. Yet the case studies clearly demonstrate that microcomputers are not releasing working-class talent on the expected scale. Possibly it is still too soon to expect results; probably the greater likelihood that middle-class children have access to a home computer is still a factor. But perhaps part of the answer lies again in the image of NIT, a feeling that "this is not for us".

C. NIT and the Information Society

169. NIT is a largely unexplored continent to most of the world's population; concealed by its esoteric language and subculture, it is perceived as populated by a superior race. The computer professional is traditionally seen as a highly-motivated (perhaps mildly obsessional) person of little culture or aesthetic sense with an overdeveloped interest in cold logic and clearcut decision rules. Like all stereotypes, this one is often far-wrong in individual cases, and ought to be reviewed continually! However, surprisingly little attention has so far been paid to the social and cultural effects of NIT on the host society. We must anticipate a world in which computers and NIT are as mainstream and as firmly embedded in the fabric of society as is the motor car now -- a world in which the diehard computer enthusiast will be seen to be as eccentric as the self-taught motoring pioneers of the 1920s might appear today.

170. The comparison between motor cars and computers is instructive. Formal education tends to neglect the motor car as a subject for general education. This is not because motor vehicles are unimportant in society, but because developed countries already offer such a rich environment for young people to learn about motor vehicles and their impact. The vocabulary of traffic congestion, automatic transmisson, motorway regulations, air pollution, body aerodynamics and tyre pressures does not need to be taught as a school "subject". It is inhaled with the atmosphere of a motorised society, picked up through direct experience of family motoring or public buses and coaches, reinforced by the mass media, and ultimately, for many, formalised in the passing of a driving test and eventually car ownership.

171. If NIT had developed over a century, it might have been possible to create an equally rich and equally natural environment for people to learn about NIT as part of growing up. But the pace of change demands purposeful campaigns, not laissez-faire.

CONCLUSION

172. The computer is morally neutral: a force for good or evil, depending on *how* it is used. But it is also a once-in-many-centuries invention of immense potency. Its extension into NIT was both technologically and commercially inevitable. The values of society can only be safeguarded if NIT literacy is widespread in the general population, among politicians, administrators, housewives, shopkeepers and trade union officials. NIT devices and networks must be made transparent to ordinary people. Otherwise citizens' and politicians' legtimate concerns will be pre-empted by the technocrats of the NIT industry.

173. For most people, the hardest part of the journey towards computer literacy is taking the first step. Once started, success and confidence breed more success. There is thus a strategic as well as an egalitarian argument that general education in NIT should aim at helping as wide an audience as possible to surmount the initial threshold. The BBC Computer Literacy Projects have demonstrated the success of such mass campaigns, and illustrated how quickly erstwhile novices can give others basic induction while continuing to increase their own knowledge and confidence. A rapidly increasing pool of people with a good basic grasp of the principles and an attitude of being unafraid is a healthy base upon which to build the foundations of an information society.

174. This task is urgent. Society has yet to catch up with the implications of the first generation of computers. Already cheap artificial intelligence in the shape of fifth-generation computing is imminent, electronic networks are proliferating, massive data bases are being combined clandestinely and citizens' rights are continually being eroded. Governments and big businesses are not immune: the computer frauds and security breaches which are reported are clearly only the tip of a large iceberg, and the ease with which schoolchildren have been known to break into US defence computers illustrates a potential threat to national security. Meanwhile, the number of components packed onto each tiny chip of silicon continues to double each year, dramatic reductions in the size and price of computer memory continue, digital electronics, videodisc technology and telecommunications innovations continue to converge, and recent advances in biotechnology promise to pose a fresh set of social and ethical problems.

175. It is later than we think. Information technology is here and now. It is much too important to be left to NIT professionals.